Weekly Operations Review

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Providing high quality light to users in a consistent and reliable manner is one of the main goals of the accelerator physics group. To meet this goal a large fraction of our time is spent monitoring the performance of the machine. At the Group's weekly meeting the performance of the accelerator over the previous week's run is reviewed. Graphs of various parameters which characterize the performance of the storage ring are presented and discussed.

Figures 1 and 2 show plots of the accelerator's performance for a typical week (January 25–30, 2000). For this particular week the users began at 8:00 AM on the 25th (1/3 into day 1) and ended at 8:00 AM on the 30th (1/3 into day 5). The beginning of day 1 and the end of day 5 were used for accelerator physics studies and accelerator maintenance.

RELIABILITY

The plot of beam current over time (Fig. 1A) is a measure of how reliably beam has been delivered. Beam drop-outs are noted and the causes discussed by the group. Action is taken to correct recurring problems.

BRIGHTNESS, LIFETIME, CURRENT, AND BEAM SIZE

The lifetime, τ, in the ALS is predominantly determined by intrabeam (Touschek) scattering. The lifetime is proportional to the transverse beam size, σ_x and σ_y, and inversely proportional to current, I:

$$\tau \propto \frac{\sigma_x \sigma_y}{I}$$

A figure of merit for brightness which we call the Touschek factor, *Tou*, (Fig. 1D) which we define as

$$Tou \propto \frac{\tau I}{\sigma_x \sigma_y}$$

The brightness of the beam increases with *Tou*.

During a run, *Tou* should remain constant. Changes in *Tou* mean changes in the beam quality and are usually indicative of a problem with the machine. The parameters which determine the Touschek factor are plotted in Fig. 1: beam intensity (Fig. 1A), beam lifetime (Fig. 1B), and beam size (Fig. 1C).

The transverse beam size is a function of the betatron tune. The betatron tune changes when the insertion device gap position changes. Changes in the insertion device gap position are plotted in Fig. 1F and the resulting vertical tune changes are plotted in Fig. 1 E. The vertical tune is shifted higher when the gaps are closed which moves the tune closer to the coupling resonance. This coupling of the horizontal and vertical betatron tunes causes the beam size to increase vertically. These vertical tune changes are partly responsible for changes in the vertical beam size (Fig. 1 C). Plans are in place to implement a tune feedforward scheme for the insertion device in the near future.

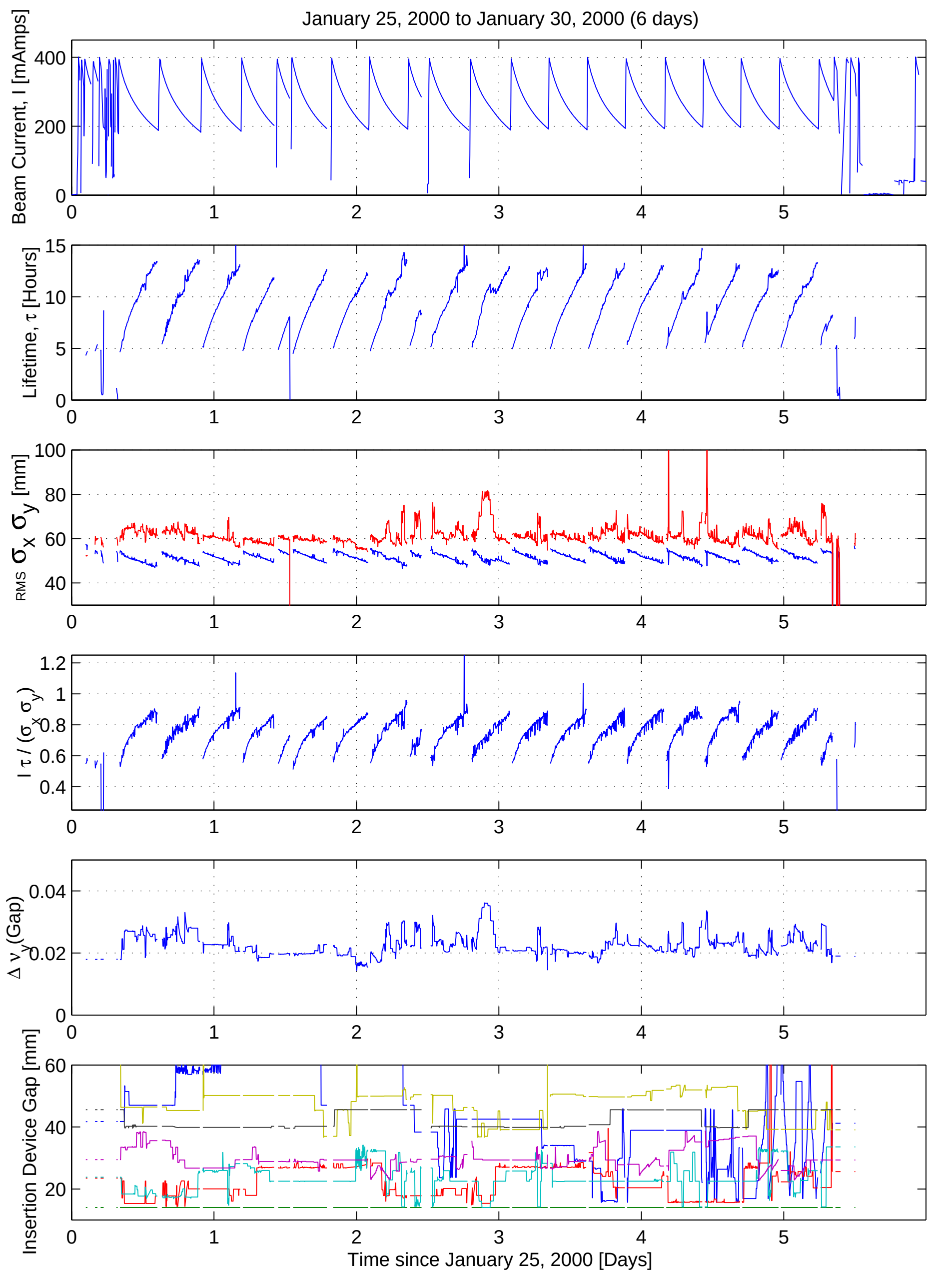

Figure 1. Beam current, lifetime, beamsize, Touschek factor, tune changes, and insertion device gap positions for a typical week (January 25–30, 2000).

POSITIONAL STABILITY

In order to stabilize the beam position, the orbit of the beam in the storage ring is corrected every 10 seconds. This holds the beam position constant at the upstream and downstream ends of most of the straight sections.

The performance of the correction algorithm is monitored routinely and adjusted if required to optimize performance. Figure 2 shows the vertical position of the beam at beam position monitors at the ends of the straight sections and in the curved section of Sector 9 over a week's run. With the exception of BPM 5-2, the BPMs showing large deviations were not in the correction algorithm. The position of the beam at the other BPMs that were in the correction loop remained constant within a few microns for the duration of the run.

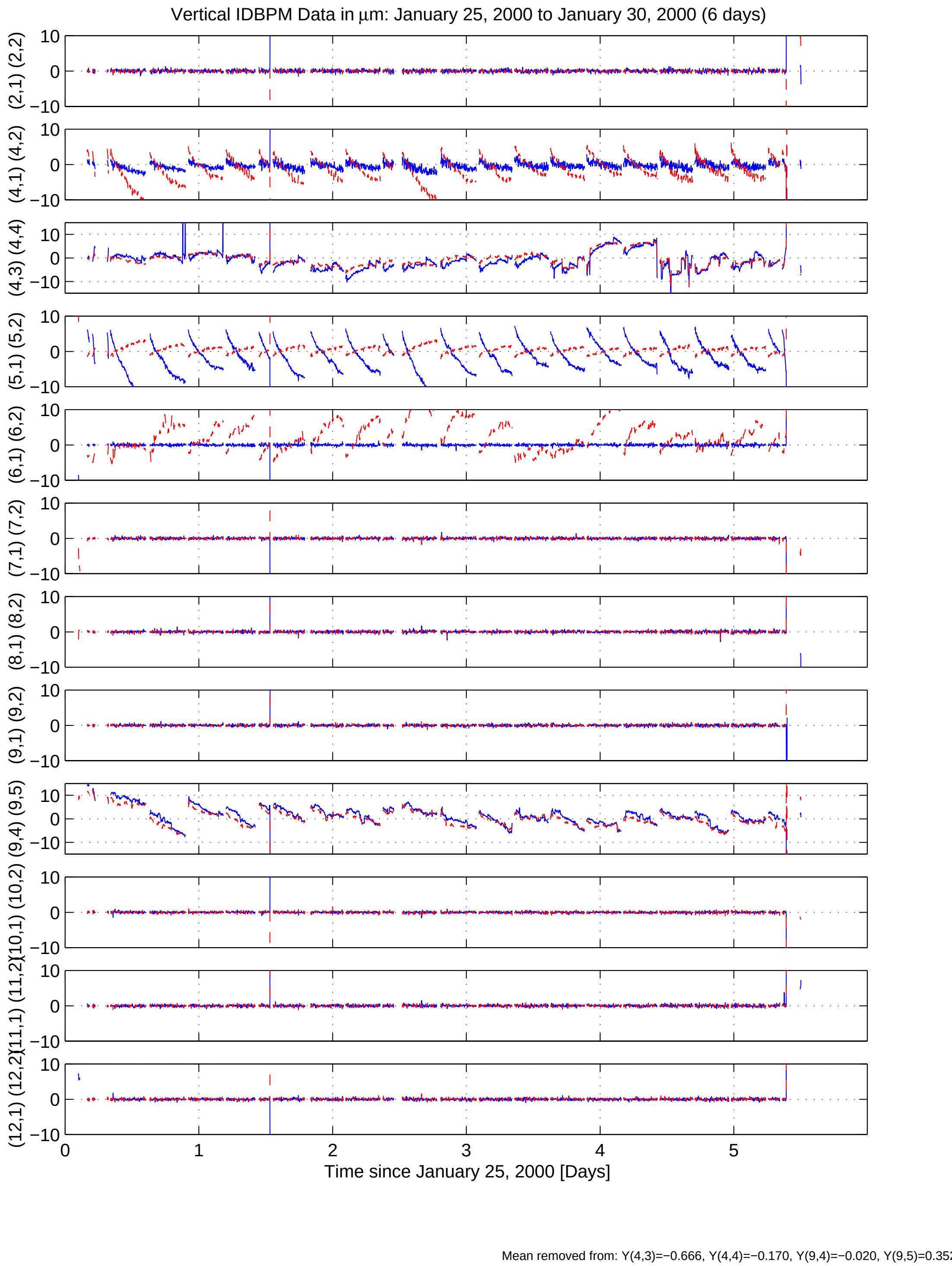

Figure 2. Vertical beam motion in the insertion device straight sections.

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